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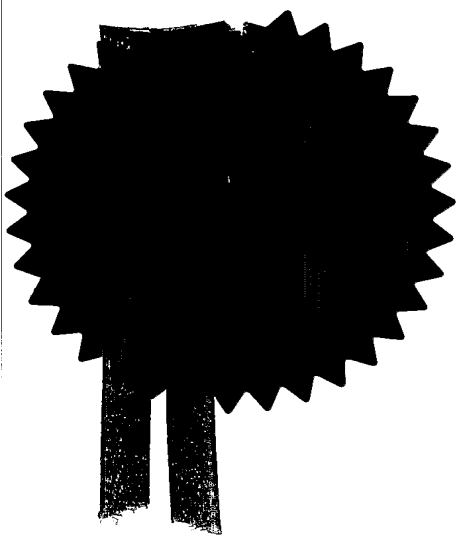

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Patents ADP number *(if you know it)*

3501080010

If the applicant is a corporate body, give the country/state of its incorporation

UK

4. Title of the invention

WASTE COMPACTING METHOD

5. Name of your agent *(if you have one)*

Harrison Goddard Foote

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Signature: Harrison Goddard Foote.

Date: 9 March 2004

12. Name and daytime telephone number of person to contact in the United Kingdom: Tony Chalk 0113 233 0100

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WASTE COMPACTING METHOD

Field of the Invention

The present invention relates to the disposal of waste and provides a novel method for the collection and dewatering and/or filtration of waste materials. The method is especially concerned with the safe disposal of waste sludge, and finds particular application in the disposal of waste materials which occur in the nuclear industry.

Background to the Invention

The identification of safe and environmentally acceptable disposal methods for waste materials generated in the nuclear industry is a constant source of challenge to workers in that industry. The enduring nature of radioactive contamination necessitates an ongoing search for new and innovative methods of treatment which facilitate the safe long term storage of these materials.

Many existing methods of disposal require the solidification of the waste materials by means of suitable encapsulants, and this has, in fact, proved to be an especially favoured method for the disposal of waste materials in the nuclear industry, since it provides a suitable means for the conversion of highly toxic materials into a stable and safe form, which allows for their long term storage and/or ultimate disposal.

In the nuclear industry wet, often fairly dilute, sludges have been generated for many years. They arise either from current operations, or from the desire to empty old storage vessels such as ponds and silos, and the procedure for disposal involves the preparation of the wastes for encapsulation for long term storage. These operations, particularly in the case of old ponds and silos, often require long settled sludges to be refluidised, transported significant distances to treatment plants, and packaged in a form suitable for long term storage. However, the final volume occupied by such wastes is greatly reduced, along with the costs associated with long term storage in a repository, if the water content of the sludges is reduced. Hence simple, robust methods for reducing the water content of these waste materials are highly desirable.

Typically, fluid wastes of this type in the nuclear industry, for which dewatering and compaction are desirable, are stored directly in engineered drums. In most cases, radioactivity and long term storage requirements necessitate that the waste should eventually be grouted and overpacked with a cementitious material. Dewatering of such wastes is traditionally carried out in the nuclear and other industries by means of techniques such as sandbed filtration and cross-flow ultra-filtration, the products of such processes subsequently being encapsulated in cement, as described, for example, in Chapter 9 of "*The Nuclear Fuel Cycle*", P D Wilson, Ed., Oxford Press, 1996. Unfortunately, however, these methods are unable to provide residual waste materials having a sufficiently low water content for ultimate disposal, or to produce sludges which are non-flowing. Thus, the present invention seeks to provide a more effective procedure for dewatering and/or filtration of liquid wastes, such that the water content is reduced to a significantly lower level than is possible by employing the methods of the prior art.

A particular form of waste which commonly occurs in the nuclear industry is a liquid-based slurry, containing significant amounts of solid material, an example being so-called Intermediate Liquid Waste. Consequently, the present invention seeks to provide a means by which a waste material of this type may be quickly and efficiently reduced in volume, the liquid removed to as great an extent as possible, and the residual solid significantly compacted, in order to provide a residue which has the potential for subsequent disposal and/or storage by means of encapsulation or a related technique. Alternatively, if the dewatered solid is not suitable for encapsulation, the method of the invention does at least provide the waste material in a more suitable form for long term storage than is the case with the original suspension or dispersion.

Statements of Invention

Thus, according to the present invention there is provided a method for the reduction of the volume of solid/liquid dispersion or suspension, said method comprising the steps of:

(a) providing a receptacle comprising a permeable or semi-permeable membrane;

(b) introducing said solid/liquid dispersion or suspension into said receptacle; and

(c) applying a mechanical force so as to substantially expel said liquid and compact the solid residue.

Preferably said solid/liquid dispersion or suspension comprises a slurry, most commonly an aqueous slurry, of a solid material. The invention is particularly applicable in cases where said solid/liquid dispersion comprises a waste material, most particularly a waste material generated in the nuclear industry.

Said receptacle generally comprises a container such as a barrel, and said permeable or semi-permeable membrane is most preferably a suitable filter device, typically a woven material, which is integrated into the surface of the receptacle. Most conveniently, said permeable or semi-permeable membrane is comprised in the base of said receptacle, thereby allowing for the introduction of the solid/liquid dispersion or suspension into the top of the receptacle, whereupon the liquid may partially permeate through the membrane, whilst the solid material is retained within the receptacle.

The substantial expulsion of the liquid from the receptacle, and the subsequent compaction of the solid residue, relies on the application of a mechanical force. Said mechanical force typically provides an increase in the pressure applied to the solid/liquid dispersion or suspension, such that the liquid comprised therein is forced, to the greatest extent possible, to pass through the permeable or semi-permeable membrane; subsequently, compaction of the solid takes place.

Description of the Invention

In one embodiment of the invention, the pressure applied to the solid/liquid dispersion or suspension may be increased by indirect means, such that an increase in

the gas pressure within the receptacle is effected, in order that the said pressure exceeds atmospheric pressure. This may conveniently be achieved by closing all sections of the receptacle other than the permeable or semi-permeable membrane and a means of ingress, and introducing a gas supply, via said means of ingress, to act on the dispersion or suspension; typically, this would involve the introduction of a supply of compressed air into the receptacle.

Alternatively, in a second embodiment of the invention, the pressure applied to the solid/liquid dispersion or suspension may be increased by direct means, involving the direct action of a mechanical member on the said dispersion or suspension. Most conveniently, said mechanical member may comprise an inflatable member, placed within the receptacle and adapted to act on the dispersion or suspension when inflated in order to physically force the liquid through the permeable or semi-permeable membrane. Subsequently, following expulsion of the liquid, the inflatable member may be further inflated in order to act upon the residual solid and physically compact said solid. Preferably said inflatable member may comprise an air bag, which may be inflated by the ingress of a supply of gas, preferably compressed air, provided from a suitable external supply. Optionally, said inflatable member may additionally comprise a rigid member, to more effectively expel liquid from the residual solid and thereafter compact the residual solid. Said rigid member may, for example, comprise a base plate, preferably comprised of metal.

In operation, all sections of the receptacle would be closed other than the permeable or semi-permeable membrane and a means of ingress. Said inflatable member would be attached to the means of ingress, and the supply of, typically, compressed air would be introduced, via said means of ingress, into said inflatable member to inflate said member and cause it to act on the dispersion or suspension.

In the case of either embodiment hereinbefore disclosed, the receptacle containing the solid compacted material may, following the use of the method of the invention,

be ruptured and compacted prior to encapsulation, or containment within a waste repository, according to which is most appropriate in the individual circumstances.

In a third embodiment of the invention, the compaction of the solid residue from the waste material additionally comprises compression of the receptacle. Thus, following the introduction of the solid/liquid dispersion or suspension into the receptacle, all sections of the receptacle are closed and preferably sealed, other than the permeable or semi-permeable membrane, and a direct mechanical force is applied to the receptacle so as to compress the receptacle at the same time as forcing the liquid through the membrane and compressing the solid residue. The direct mechanical force may be applied by any convenient means capable of effectively crushing the receptacle – typically, for example, by the action of a hydraulic ram – and is most conveniently applied to the top of the receptacle. Following the compacting procedure, the residual compacted solid, together with the remnants of the crushed receptacle, may be sent for storage or disposal by means of encapsulation, or containment within a waste repository, as appropriate.

The method of the present invention is especially suitable for the processing of waste slurries and finds particular application in the treatment of waste slurries produced in the nuclear industry, notably in the treatment of Intermediate Liquid Waste in preparation for its ultimate storage and/or disposal by encapsulation, containment or other suitable means.

Detailed Description of the Drawings

The method of the invention will now be illustrated, though without limitation, by reference to the accompanying diagrams, in which:

Figure 1 illustrates a first embodiment of the method of the invention, wherein the pressure applied to the solid/liquid dispersion or suspension is increased by means of a supply of compressed air;

Figure 2 illustrates a second embodiment of the method of the invention, wherein the pressure applied to the solid/liquid dispersion or suspension is increased by means of an inflatable air bag placed within the receptacle; and

Figure 3 illustrates a third embodiment of the method of the invention, wherein the pressure applied to the solid/liquid dispersion or suspension is increased by means of a hydraulic ram, which compacts both the solid residue and the receptacle.

Referring firstly to Figure 1, there is shown a receptacle in the form of a barrel 1 comprising a semi-permeable membrane comprising a filter 2. A solid/liquid suspension 3 is introduced into the barrel 1 and supply of compressed air 4 is provided at the top of the barrel 1 in order to force the liquid filtrate 5 to exit through the filter 2, whilst the solid is retained on the filter 2 and is subsequently dewatered to form the residue 6.

Turning now to Figure 2, there is shown a receptacle in the form of a barrel 7 comprising a semi-permeable membrane comprising a filter 8 and a lid 9 incorporating an orifice (not shown) to which is attached an inflatable air bag 10. A solid/liquid suspension 11 is introduced into the barrel 7 and supply of compressed air 12 is introduced into the air-bag 10 via the orifice, so as to gradually inflate the air bag.10, thereby initially forcing the liquid filtrate 13 to exit through the filter 8, whilst the solid is retained on the filter 8. Subsequently, the air bag 10 is fully inflated, in order that the residue 14 becomes compacted on the filter 8.

Finally, in Figure 3 there is shown a receptacle in the form of a barrel 15 comprising a semi-permeable membrane comprising a filter 16. The barrel 15 is placed on supporting members comprising blocks 17 above a drainage duct 18. A solid/liquid suspension 19 is introduced into the barrel 15 and said barrel is then sealed. A hydraulic ram 20 located above the barrel 15 is then caused to act on said barrel in a downward motion, thereby forcing the liquid filtrate 21 to exit through the filter 16,

whilst at the same time compacting the solid and crushing the barrel 15 to leave a compacted mass 22 on the blocks 17.

CLAIMS

1. A method for the reduction of the volume of solid/liquid dispersion or suspension, said method comprising the steps of:

    (a) providing a receptacle comprising a permeable or semi-permeable membrane;
    (b) introducing said solid/liquid dispersion or suspension into said receptacle; and
    (c) applying a mechanical force so as to substantially expel said liquid and compact the solid residue.

2. A method as claimed in claim 1 wherein said solid/liquid dispersion or suspension comprises a slurry of a solid material.

3. A method as claimed in claim 2 wherein said slurry comprises an aqueous slurry.

4. A method as claimed in any one of claims 1, 2 or 3 wherein said solid/liquid dispersion comprises a waste material.

5. A method as claimed in claim 4 wherein said waste material comprises a waste material generated in the nuclear industry.

6. A method as claimed in any one of claims 1 to 5 wherein said receptacle comprises a barrel.

7. A method as claimed in any preceding claim wherein said permeable or semi-permeable membrane comprises a filter.

8. A method as claimed in claim 7 wherein said filter comprises a woven material.

9. A method as claimed in any preceding claim wherein said permeable or semi-permeable membrane is integrated into the surface of the receptacle.

10. A method as claimed in claim 9 wherein said permeable or semi-permeable membrane is comprised in the base of said receptacle.

11. A method as claimed in any preceding claim wherein said application of a mechanical force to substantially expel said liquid from said receptacle and compact said solid residue provides an increase in the pressure applied to said solid/liquid dispersion or suspension.

12. A method as claimed in claim 11 wherein said increase in the pressure applied to said solid/liquid dispersion or suspension is achieved by indirect means.

13. A method as claimed in claim 12 wherein said indirect means comprises an increase in the gas pressure within the receptacle.

14. A method as claimed in claim 13 wherein said increase in the gas pressure within the receptacle is effected by the introduction of a supply of compressed air into the receptacle.

15. A method as claimed in claim 11 wherein said increase in the pressure applied to said solid/liquid dispersion or suspension is achieved by direct means.

16. A method as claimed in claim 15 wherein said direct means comprises the direct action of a mechanical member on said dispersion or suspension.

17. A method as claimed in claim 16 wherein said mechanical member comprises an inflatable member located within said receptacle.

18. A method as claimed in claim 17 wherein said inflatable member comprises an air bag.

19. A method as claimed in claim 17 or 18 wherein said inflatable member is inflated by the ingress of compressed air.

20. A method as claimed in any one of claims 17 to 19, wherein said inflatable member additionally comprises a rigid member.

21. A method as claimed in claim 20 wherein said rigid member comprises a base plate.

22. A method as claimed in claim 21 wherein said base plate is comprised of metal.

23. A method as claimed in any one of claims 1 to 11 wherein said application of a mechanical force to substantially expel said liquid from said receptacle and compact said solid residue additionally comprises compression of the receptacle.

24. A method as claimed in claim 23 wherein said application of a mechanical force comprises the application of a direct mechanical force to the receptacle so as to compress the receptacle at the same time as forcing the liquid through the membrane and compressing the solid residue.

25. A method as claimed in claim 24 wherein said direct mechanical force is applied to the top of the receptacle.

26. A method as claimed in claim 24 or 25 wherein said direct mechanical force is applied by the action of a hydraulic ram.

27. A method as claimed in any preceding claim wherein the residue is subsequently despatched for storage or disposal.

28. A method as claimed in any preceding claim whenever applied to the treatment of Intermediate Liquid Waste in the nuclear industry.

29. A method as hereinbefore defined and with reference to the accompanying drawings.

ABSTRACT

The invention provides a method for the reduction of the volume of solid/liquid dispersion or suspension, the method comprising the steps of:

(a) providing a receptacle comprising a permeable or semi-permeable membrane;
(b) introducing the solid/liquid dispersion or suspension into the receptacle; and
(c) applying a mechanical force so as to substantially expel the liquid and compact the solid residue.

The receptacle generally comprises a barrel, the permeable or semi-permeable membrane is most preferably a filter, and the mechanical force is typically applied by means of a source of compressed air, an inflatable air bag, or a hydraulic ram. In the latter case, the compaction of the solid residue from the waste material additionally comprises compression of the receptacle. In all embodiments of the invention, the residue obtained is suitable for storage or disposal by any appropriate means. The solid/liquid dispersion or suspension preferably comprises an aqueous slurry of waste material, most preferably an Intermediate Liquid Waste slurry generated in the nuclear industry.

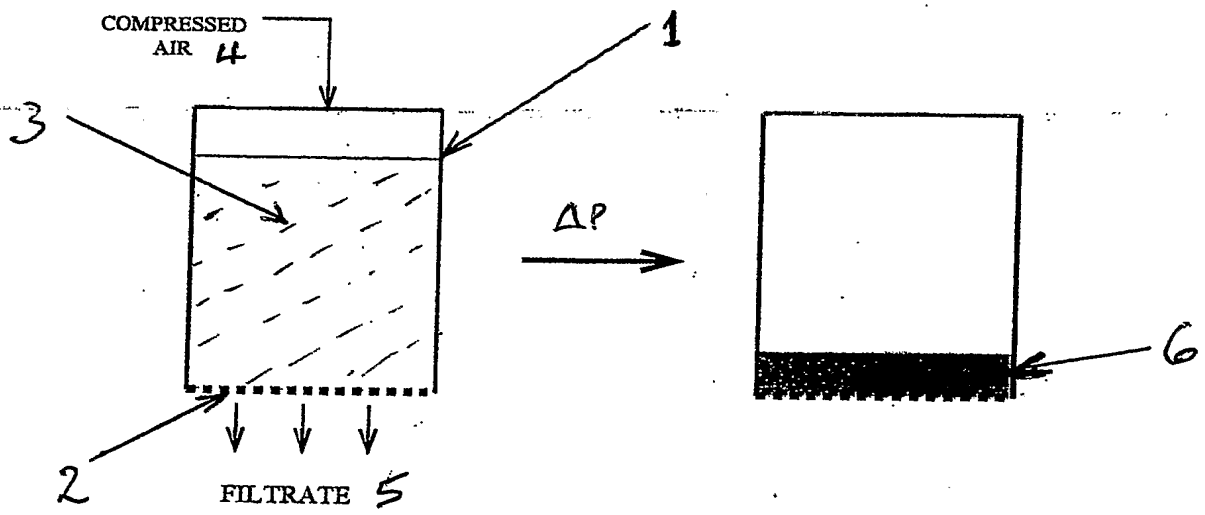

FIGURE 1

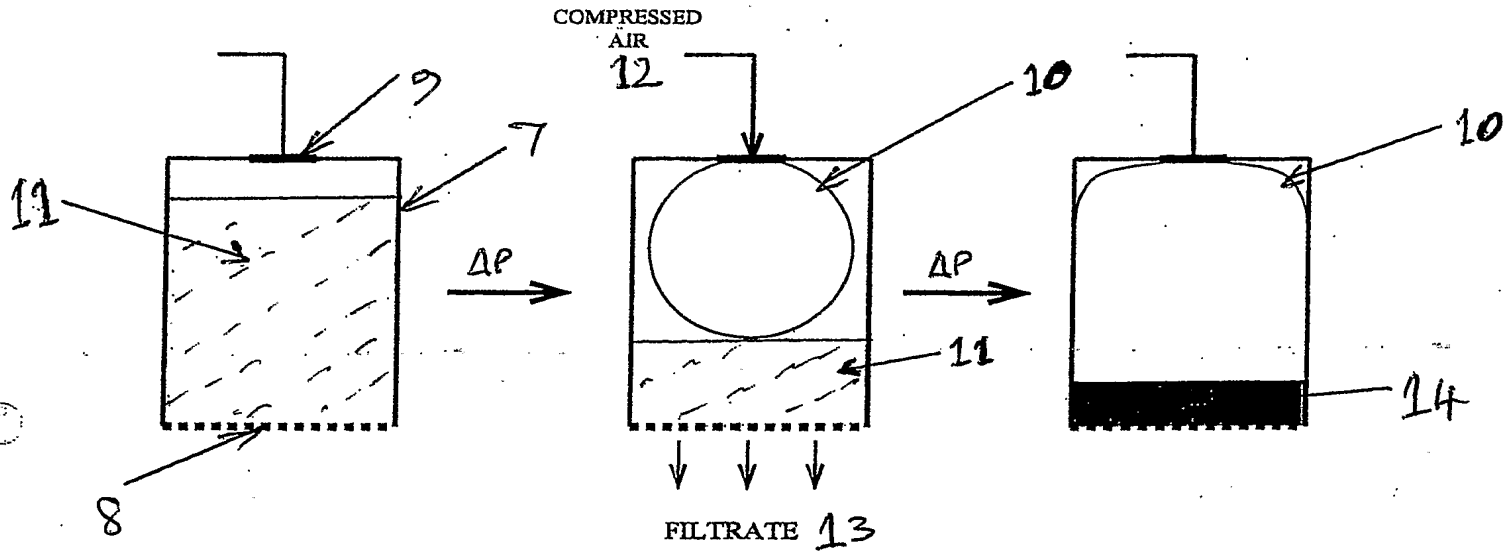

FIGURE 2.

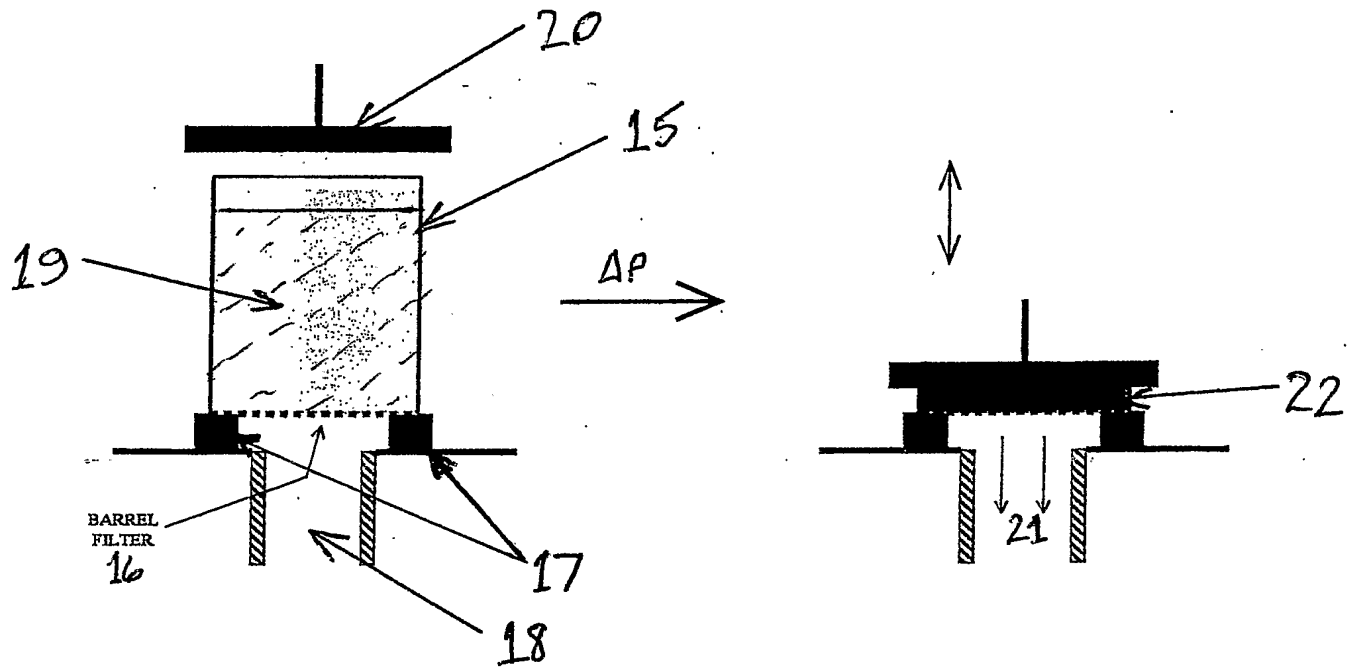

FIGURE 3